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Finding Ocean Structures Using Mathematical Morphology

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13. Abstract (Maximum 200 words).

IR satellite images are used extensively to study ocean dynamics; their synoptic coverage complements traditional oceanographic measurements. Data interpretation is complicated by cloud cover and the features' spatial and temporal variation. The opening and closing operation of mathematical morphology smooths edges and finds objects simultaneously; this method's success has been demonstrated in astronomical images. We will describe adaptions needed to find Gulf Stream rings in NOAA AVHRR images, and show comparisons of the results with those from both human analysts and other automated techniques. Processing consists of inverting the image, applying opening and closing to separate very hot objects (generally land, the Gulf Stream, and some clouds) from the rest of the image and to remove them, and applying opening and closing to the result to separate remaining hot objects from the background (usually cold water), which is also removed.

In opening and closing, objects are defined by minimum size and intensity threshold criteria. The latter criterion varies locally in the image. The structure element, a pattern of pixels whose properties are those sought in the image, is a uniform intensity 3 x 3 pixel array. Opening and closing involves alternately considering whether the entire structure element fits under the image's intensity surface when the structure element is centered on a particular pixel, and whether any part of the structure element fits under the intensity surface. Hence the method works better for warm core eddies than for cold core eddies. It will miss eddies that differ only slightly from their surroundings in temperature and find areas of water whose temperature differs appreciably from that of the surrounding water. The successful adaptation of a technique originally developed for a different discipline is a*

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*welcome step in the development of automated tools to aid the interpreter; it is also an example of cooperation between the academic community and the Federal Government. We will present preliminary results of a study of techniques to improve the method's efficiency and reliability.

(cont'd) * Keywords: Oceanographic data; Artificial intelligence; Mathematical models/morphology; Ocean currents/models; Infrared images; Image processing. (MM)

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